CONTINUATIO DISSERTATIONIS

De

EXPANSIONE HYDRARGYRI A CALORICO,

QUAM

Conſent. Amplisſ. Philoſ. Ordine,

PRÆSIDE

M. GUST. GABR. HÄLLSTRÖM,

Phyſ. Prof. Reg. & Ord. atque Reg. Societ. Oec. Fen Membro,

pro ſummis

in Philoſophia honoribus obtinendis

exhibet

CAROLUS FR. CAVALLIUS,

Stip. Bilmark. Gothus.

In Regio Lyceo Auraico die XX M. Oct. A. MDCCCIV.

H. A. M. S.

ABOÆ, Typis Frenckellianis.

VIRIS,

Summe Reverendo & Celeberrimo

DOMINO

Doct. SAMUELI LEMCHEN,

Ad Lyc. Carol. S. S. Theol. Prof. Reg. & Ordin.

AVI MATERNI FRATRI MAXIME
VENERANDO;

Plurimum Reverendo & Percelebri

DOMINO

Mag. LAURENTIO WADELL,

Reg. Majeſt. a Sacris & Paſt. Eccleſ. in Skårſtad;

ATQUE

Admodum Reverendo & Præclariſſimo

DOMINO

Mag. AND. HARALD. COLLIN,

Ad Gymn. Wex. Adj. Inf. & Bibl. Aman.

Præceptori olim cariſſimo;

Fautoribus Optimis

Sacrum.

Debuit
CAROLUS FRED. CAVALLIUS.

In Disſertatione, cujus continuationem loco ſpecimi-nis academici, bona Lectoris venia, publicæ jam ſubjicimus cenſuræ, duæ obveniunt æquationes diver-ſæ, quarum ope determinari poteſt volumen hydrargyri in data caloris temperatura. Una earum exactam ejus præbet menſuram (quatenus nempe experimen-ta, quibus nititur calculus, pro exactis adhiberi pos-ſunt), operoſiorem vero exigit in ipſa applicatione calculum, nec ope logarithmorum commode confi-ciendum. In altera omiſſa eſt exquiſitiſſima exacti-tudo, ut faciliore computatione, ſaltem pro gradibus caloris, temperaturæ aquæ congelantis propioribus, inveniretur volumen quæſitum. Cum itaque appa-reat, hanc pro majore calore, ex. gr. ebullitionis hydr-argyri, non eſſe adhibendam; illam in aliam reduce-re voluimus formam commodiorem, quæ ſalva exactitudine facilem permitteret determinationem o-pe logarithmorum.

Facto volumine hydrargyri = 1 in calore aquæ congelantis, ejus vero augmento = x pro aucto calore

a $o°$ ad $n°$ in thermometro centeſimali, ita ut pro gradu caloris n volumen hydrargyri ſit $= 1 + x$; inventum eſt fieri $1 + x =$

$$\left(1 + \frac{(325 + 2n)n}{62500000}\right)^2 \left(1 + \frac{(325+2n)n}{62500000} + 0{,}000150354n\right).$$

Si jam hujus æquationis membrum poſterius multiplicando evolvitur, apparet, inveniri terminos, qui qvantitatem n usque ad ſextam poteſtatem elevatam complectuntur, hancque formam æquationis oriri: $1 + x = 1 + C^{I}n + C^{II}n^2 + C^{III}n^3 + C^{IV}n^4 + C^{V}n^5 + C^{VI}n^6$, denotantibus, C', C'', C''', &c. coëfficientibus conſtantibus. Ut vero hæ determinentur, ponatur

$a = \frac{325}{62500000} = 0{,}00000520$; $b = \frac{2}{62500000} = 0{,}00000032$;

& $c = 0{,}000150354$; quo facto erit $1 + x = (1 + an + bn^2)^2 (1 + (a + c)n + bn^2)$, unde multiplicando invenitur:

$$1 + x = 1 + \left.\begin{matrix} 3a \\ + c \end{matrix}\right\} n + \left.\begin{matrix} 3a^2 \\ + 3b \\ + 2ac \end{matrix}\right\} n^2 + \left.\begin{matrix} a^3 \\ + 6ab \\ + a^2c \\ + 2bc \end{matrix}\right\} n^3 + \left.\begin{matrix} 3a^2b \\ + 3b^2 \\ + 2abc \end{matrix}\right\} n^4 + \left.\begin{matrix} 3ab^2 \\ + b^2c \end{matrix}\right\} n^5 + b^3n^6.$$

Hoc modo itaque determinati ſunt valores coëfficientium, ut ſit

$$C' = 3a + c,$$
$$C'' = 3a^2 + 3b + 2ac,$$
$$C''' = a^3 + 6ab + a^2c + 2bc,$$

$C^{IV} =$

$C_{IV} = 3a^2b + 3b^2 + 2abc,$
$C_V = 3ab^2 + b^2c,$
$C_{VI} = b^3,$

unde, ſubſtitutis valoribus quantitatum a, b & c, inveniuntur

$Log.\ C' = 0,\ 2199877 - 4.$
$Log.\ C'' = 0,\ 9896491 - 8.$
$Log.\ C''' = 0,\ 0263379 - 11.$
$Log.\ C_{IV} = 0,\ 4947990 - 15.$
$Log.\ C_V = 0,\ 2302878 - 19.$
$Log.\ C_{VI} = 0,\ 5154500 - 23.$

His autem cognitis non incommodus erit uſus æquationis $1 + x = 1 + C'n + C''n^2 + C'''n^3 + C_{IV}n^4 + + C_Vn^5 + C_{VI}n^6$, & quidem eo commodior, quo minor ſumitur n, ut nempe altiores ejus dignitates, propter parvitatem coëfficientium, negligi poſſint.

Notum eſt, hydrargyrum in vapores mutari quando usque ad temperaturam 315° calefactum eſt (*). Maximus itaque hic adhibendus valor qvan-

(*) Diu jam crediderunt Phyſici, ebullitionis mercurii calorem eſſe 600° Fahrenheitii ſeu 315⅝ Celſii. Nuperrime quoque vidimus in Novellis litterariis Halenſibus, de novo determinatum eſſe hunc ebullitionis calorem. Nondum autem ad nos pervenit part. 5 pro anno 1804 Annalium phyſicorum

titatis n eſt 315. Etiamſi autem ſiat $n = 315$, ſine metu erroris tamen negligi poteſt terminus $C^{VI} n^6$, qui minor eſt parte decies millies milleſima. Cumque in hac determinatione ſufficiat exactitudo partis centies milleſimæ, idem valet de termino $C^{V} n^5$, qui pro $n = 315$ minor eſt parte millies milleſima; unde facile apparet, terminos $C^{V} n^5$ & $C^{VI} n^6$ ſemper omitti poſſe. Deinde quoque facta $n = 133$ vel $n < 133$, eſt $C^{IV} n^4 < 0,000001$, adeoque pro $n < 133$ ſemper negligi poteſt hic terminus. Similiter pro $n =$ vel < 45 eſt $C''' n^3 < 0,000001$, adeoque negligendus. Tandem quoque pro $n =$ vel < 3 ſit $C'' n^2 < 0,000001$. Hæc autem omnia ita ſunt intelligenda, ut in applicatione regulæ allatæ pro valoribus quantitatis n intra -3 & $+3$ ſufficiat hæc æquatio:

$1 + x = 1 + C' n = 1 + 0,00016595\ n$;
intra -3 & -40, atque $+3$ & $+45$
hæc: $1 + x = 1 + C' n + C'' n^2$
$= 1 + 0,000165954\ n + 0,0000000976\ n^2$;
intra 45 & 133
hæc: $1 + x = 1 + C' n + C'' n^2 + C''' n^3$;
atque intra 133 & 315
hæc: $1 + x = 1 + C' n + C'' n^2 + C''' n^3 + C^{IV} n^4$.

His

Cel. GILBERT, ubi diſſertatio de hac re legi poteſt.

His nixi principiis ſequentem computavimus tabellam

Calor	Volumen hydrargyri	Calor	Volumen hydrargyri	Calor	Volumen hydrargyri
— 40	0,99352	— 10	0,99835	+ 20	1,00336
— 39	0,99368	— 9	0,99851	21	1,00353
— 38	0,99383	— 8	0,99868	22	1,00370
— 37	0,99399	— 7	0,99884	23	1,00387
— 36	0,99415	— 6	0,99901	24	1,00404
— 35	0,99431	— 5	0,99917	25	1,00421
— 34	0,99447	— 4	0,99934	26	1,00438
— 33	0,99463	— 3	0,99950	27	1,00455
— 32	0,99479	— 2	0,99967	28	1,00472
— 31	0,99495	— 1	0,99983	29	1,00489
— 30	0,99511	— 0	1,00000	30	1,00507
— 29	0,99527	+ 1	1,00017	31	1,00524
— 28	0,99543	2	1,00033	32	1,00541
— 27	0,99559	3	1,00050	33	1,00558
— 26	0,99575	4	1,00066	34	1,00576
— 25	0,99591	5	1,00083	35	1,00593
— 24	0,99607	6	1,00100	36	1,00610
— 23	0,99623	7	1,00117	37	1,00627
— 22	0,99640	8	1,00133	38	1,00645
— 21	0,99656	9	1,00150	39	1,00662
— 20	0,99672	10	1,00167	40	1,00679
— 19	0,99688	11	1,00184	50	1,00854
— 18	0,99704	12	1,00201	60	1,01031
— 17	0,99721	13	1,00217	70	1,01210
— 16	0,99737	14	1,00234	80	1,01391
— 15	0,99753	15	1,00251	90	1,01573
— 14	0,99770	16	1,00268	100	1,01758
— 13	0,99786	17	1,00285	200	1,03719
— 12	0,99802	18	1,00302	300	1,05880
— 11	0,99819	19	1,00319	315	1,06233

Quamdiu liquidum manet hydrargyrum, credimus quidem, allatam regulam determinandi ejus volumen pro quibusvis caloris vel frigoris gradibus valere. Quamprimum autem in vapores mutatur, vel in formam ſolidam abit, in illo caſu dilatatur, in hoc vero condenſatur magis, quam ut ſine cautione tum adhibenda eſſet regula. Quod præſertim hydrargyrum ſolidum attinet, ſequenti modo ejus volumen determinari poſſe putamus.

Notum eſt, ejus congelationem fieri circa frigoris gradum quadrageſimum, in ipſo autem illo momento ſimul ita condenſari, ut ſecundum obſervationes Cel. Braunii in thermometro centeſimali gradum — $333\frac{1}{3}$ oſtendere poſſit (*). Ut itaque inveniatur volumen hydrargyri congelantis, non ſufficit in æquatione nuper allata ſumere $n = -40$; hoc enim

(*) Fraunius, qui primus congelationem hydrargyri obſervavit, credidit frigus hujus congelationis eſſe 650 graduum ſcalæ Delilianæ, hoc eſt — $333\frac{1}{3}$ ſcalæ Celſianæ. (Vide ejus diſſert. *de admirando frigore artificiali quo Mercurius eſt congelatus*, in *Nov. Comment. Acad. Scient. Imper. Petropol. Tom. XI, pag.* 287, 314.). Etiamſi autem noſtris temporibus cognitum ſit, frigus 40° ſcalæ noſtræ huic congelationi ſufficere, docent tamen experimenta Braunii, condenſationem hydrargyri in ipſa congelatione fieri usque ad gradum — $333\frac{1}{3}$.

nim facto invenitur volumen hydrargyri 40° frigidi, adhuc autem liquidi. Sed debemus in æquatione $1+x=\left(1+\frac{(325+2n)n}{62500000}\right)^2\left(1+\frac{(325+2n)n}{62500000}+0{,}000150354n\right)$ dupplicem quantitatis n valorem ſubſtituere. In illa enim ejus parte, (nempe factore priore membri poſterioris) quæ correctionem ob condenſationem vitri thermometrici continet, adhibendus eſt valor $n=-40$, quoniam hæc eſt temperatura vitri, in reliqva autem, quæ hydrargyrum proprie ſpectat, $n=-333\frac{1}{3}$. Pro volumine igitur determinando ſolidi hydrargyri in frigore 40° valet hæc æquatio:

$$1+x=\left(1-\frac{325-80)\,40}{62500000}\right)^2\left(1-\frac{(325-80)\,40}{62500000}\right.$$
$$\left.-0{,}000150354.333\tfrac{1}{3}\right),$$

quæ dat volumen illud quæſitum $1+x=0{,}9494274$, facto volumine hydrargyri liquidi in temperatura aquæ congelantis = 1. Parum igitur hoc differt ab illo, quod conſiderata conſtructione thermometri Deliliani Braunius ſtatuit eſſe = 0,95 (*), neglecta tamen correctione ob condenſationem vitri thermometrici. Supra quoque inventum eſt volumen hydrargyri ebullientis=1,06233; quare, cum ſint corporum pondera ſpecifica in ratione inverſa voluminum, atque pondus ſpecificum hydrargyri in temperatura aquæ congelantis ſecundum determinationem D:ni Brisson ſumere liceat=13,568 ſequens oritur comparatio ponderum ſpecificorum hydrargyri, nempe

ſoli-

(*) L. c. p. 287.

ſolidi in frigore 40° = 14,291
liquidi in calore 0° = 13,568
ebullientis in calore 315° = 12,779.

Præterea obſervavit BRAUNIUS (*) in frigore majore, quam quod neceſsarium erat ad congelationem hydrargyri, hocce adeo ſuisſe denſum, ut ad gradum usque 1500 ſcalæ thermometri Deliliani, hoc eſt, ad — 900° ſcalæ Celſianæ, deſcenderet. Si quidem pro hocce experimento cognitum esſet frigus, modo ſupra allato determinari posſet volumen & pondus ſpecificum hydrargyri omnino ſolidi & malleabilis. Incertum enim eſt, pro quonam gradu thermometri corrigendus ſit effectus frigoris in vitrum thermometri. Si tamen pro frigore — 40° hæc correctio inſtituitur, pro ſtatu autem hydrargyri ſumitur — 900°, vero proximum invenitur volumen hydrargyri malleabilis = 0, 86425, unde eruitur pondus ejus ſpecificum = 15,699.